BUREAU OF METEOROLOGY

CSIRO

Cape Grim
Baseline Air Pollution Station
Annual Scientific Meeting, 2001

Abstracts



6-7 February, 2002
Antarctic CRC, University of Tasmania
Hobart, Tasmania, Australia

Edited by Neil Tindale & Nada Derek

Antarctic CRC

University of Tasmania

IASOS
Institute of Antarctic and Southern Ocean Studies

Cape Grim Baseline Air Pollution Station
Annual Meeting, February 2002

Wednesday 6, February		
Chair	***Paul Fraser***	
09:30	Paul Fraser	General information on arrangements etc.
09:35	Garth Paltridge	Welcome to IASOS and AntCRC
09:40	**Dr Sharman Stone**	**Official opening of meeting and presentation of Australia Day award to Laurie Porter, CGBAPS**
09:55	Guido Corno	Relationship Between Phytoplankton Production and Biogenic Gas Emission off Cape Grim
10:20	**Morning Tea**	
10:50	Wlodek Zahorowski	A Brief Review of Key Characteristics of Radon Measurements at Cape Grim 1987-2001
11:15	Henry Granek	Aerosol Transmission Efficiency of the Cape Grim 10-m Inlet
11:40	Salah Jimi	Observation of Ultrafine Aerosol Particles in the Marine Environment of Southeastern Australia
12:05	**Lunch**	
Chair	***Stephen Wilson***	
13:35	Paul Steele	The 25-year Cape Grim *in situ* CO_2 Record
14:00	Roger Francey	The Interannual Variation in Global Atmospheric $\delta^{13}C$ and its Link to Net Terrestrial CO_2 Exchange
14:25	Colin Allison	Future CO_2 Isotope Monitoring at Cape Grim
14:50	Paul Steele	The Future of CO_2 Measurement at Cape Grim
15:15	**Afternoon Tea**	
15:45	Nicholas Jones	Solar FTIR Remote Sensing of Bushfire Plumes over Wollongong, December 2001- January 2002
16:10	Paul Fraser combined talks	Trace Gas Emissions from Melbourne and Europe Deduced from AGAGE Observations at Cape Grim and Mace Head Recent Changes in the Global Abundance of Methyl Bromide from AGAGE and SIO Measurements
16:35	Melita Keywood	Aerosol Chemistry at Cape Grim: What do we know?
17:00	**Close of Papers**	
17:30	**Poster Wine and Cheese**	
19:00	**Dinner**	

Cape Grim Baseline Air Pollution Station
Annual Meeting, 2002

Thursday, 7 February		
Chair	***Arthur Downey***	
09:00	Paul Fraser	General information on arrangements etc.
09:10	Stephen Wilson	Isotopic Fractionation in Sources of Atmospheric N_2O
09:35	Simon Bentley	Development and Verification of a Spatially Explicit Inventory of Methane Emissions from Australia
10:00	Matthew Tully	Air Mass Origin – Some Sources of Error
10:25	**Morning Tea**	
11:00	Dave Etheridge	Atmospheric Composition Changes During the Past Century from Firn Air from two Antarctic Sites
11:25	Greg Ayers	CSIRO's Commitment to Cape Grim in a World of BHAGS, Emerging Science and IP Revaluation
11:50	Marc Duldig	Middle Atmosphere Research at the Australian Antarctic Division
12:15	**Lunch**	
Chair	***Paul Fraser***	
13:45	Brad Hall	Measurements of Carbonyl Sulfide at CMDL Baseline Observatories
14:10	Mick Meyer	A Spatially Explicit Inventory of Trace Gas Emissions from Wildfires and Controlled Burning over Australia
14:35	Steve Siems	TAPM Modelling Studies of Cape Grim Dichloromethane
15:00	**Afternoon Tea**	
15:30	**Workshop:** ***Chair - Paul Fraser***	**Marine-Related Cape Grim Research**
15:40-15:55	Tom Trull	**Outline of Science Directions in a New Antarctic and Southern Ocean CRC**
17:00	**Close of meeting**	

Contents

Presentations – Day 1

Relationship Between Phytoplankton Production and Biogenic Gas Emission off Cape Grim..... 5
G. Corno

A Brief Review of Key Characteristics of Radon Measurements at Cape Grim 1987-2001 6
W. Zahorowski, S. Chambers, S. Werczynski & A. Henderson-Sellers

The Aerosol Transmission Efficiency of the Cape Grim 10-m Inlet 7
H. Granek, J. Gras & D. Paterson

Observation of Ultrafine Aerosol Particles in the Marine Environment of Southeastern Australia..... 8
S. Jimi, J. Gras, S. Siems & Paul Krummel

The 25-year Cape Grim *in situ* CO_2 Record..... 9
P. Steele, G. Pearman, D. Beardsmore, F. de Silva, P. Krumme, R. Langenfelds, & Cape Grim Staff

The Interannual Variation in Global Atmospheric $\delta^{13}C$ and its Link to Net Terrestrial CO_2 Exchange..... 10
R. Francey, C. Allison, C. Trudinger, P. Rayner, I. Enting, P. Steele, L. Cooper & Cape Grim staff

Future CO_2 Isotope Monitoring at Cape Grim 11
C. Allison, R. Francey & L. Porter *12*

The future of CO_2 Measurement at Cape Grim..... 12
P. Steele, D. Spencer, P. Krummel, R. Francey, R. Law, G. Da Costa, CSIRO Engineering Staff & Cape Grim Staff

Solar FTIR Remote Sensing of Bushfire Plumes over Wollongong, December 2001 - January 2002 13
A. Meier, N. Jones & D. Griffith

Trace Gas Emissions from Melbourne and Europe Deduced from AGAGE Observations at Cape Grim and Mace Head..... 14
P. Fraser, B. Dunse, P. Steele, S. Wilson, M. Cox, S. O'Doherty, P. Simmonds & N. Derek

Recent Changes in the Global Abundance of Methyl Bromide from AGAGE and SIO Measurements 15
P. Fraser, D. Etheridge, C. Trudinger,L. Porter, M. Cox, S. O'Doherty, P. Simmonds,B. Miller, R. Weiss & N. Derek

Aerosol Chemistry at Cape Grim: What do we know? 16
M. Keywood

Posters

Oxygen Isotopes and Palaeoenvironment Reconstruction 17
P. Treble

First Year of Radon-222 Observations at the Ace-Asia Kosan Site 18
W. Zahorowski, J. Kim, S. Chambers,C.-H. Kang, S.-Nam Oh & A. Henderson-Sellers

Radon-222 Measurements at a Continental Coastal Site in Hong Kong 19
S. Chambers, T. Wang, W. Zahorowski, S. Poon & A. Henderson-Sellers

***In Situ* Investigation of Tomato Plants as Methyl Halide Sources 20**
B. Hall

***In Situ* Measurements of Carbonyl Sulfide and Methyl Chloride..... 20**
B. Hall

A Pollution History of the Southern Hemisphere recorded by Lead Isotope Measurements in Antarctic Ice..... 20
P. Vallelonga, K. van de Velde, J.-P. Candelone, K. J. R. Rosman & V. I. Morgan *21*

The following five posters are from

The Sixth International Carbon Dioxide Conference, Sendai, Japan 1-5 October 2001

Stable Isotopes of Atmospheric Carbon Dioxide from the CSIRO Global Flask Sampling Network **21**
C. Allison, R. Francey & P. Rayner

Future Directions in Atmospheric CO_2 Measurement Methods **21**
P. Steele, G. Da Costa, D. Spencer, P. Krummel, R. Francey & J. Bennett, S. Baly & L. Porter

The Interannual Variation in the $\delta^{18}O$ of Atmospheric CO_2 Over the Last 25 Years **21**
R. Francey,C. Allison, P. Ciais & G. Hoffmann

CO_2 Inversions using High Temporal Frequency Data **21**
R. Law, P. Rayner, P. Steele & I. Enting *22*

A Kalman Filter Double Deconvolution of Ice Core CO_2 and $\delta^{13}C$ Data **21**
C. Trudinger, I. Enting, P. Rayner & R. Francey

Presentations – Day 1

Isotopic Fractionation in Sources of Atmospheric N_2O **22**
S. Wilson, D. Griffith, T. Naylor, J. Menegazzo & F. Turatti

Development and Verification of a Spatially Explicit Inventory of Methane Emissions from Australia **23**
Y.-P. Wang & S. Bentley *24*

Air Mass Origin – Some Sources of Error **24**
M. Tully & A. Downey

Atmospheric Composition Changes During the Past Century from Firn Air from Two Antarctic Sites **25**
D. Etheridge, C. Trudinger, R. Langenfelds, D. Lowe, A. Smith, G. Sturrock, P. Steele, P. Fraser, R. Francey, L. Porter, A. Elcheick & M. Battle

CSIRO's commitment to Cape Grim in a world of BHAGs, Emerging Science and IP Revaluation **26**
G. Ayers

Middle Atmosphere Research at the Australian Antarctic Division **27**
M. Duldig

Measurements of Carbonyl Sulfide at CMDL Baseline Observatories **28**
B. Hall, G. Dutton & S. Montzka

A Spatially Explicit Inventory of Trace Gas Emissions from Wildfires and Controlled Burning over Australia . **29**
M. Meyer, I. Galbally, G. Cook, D.Barrett, D. Graetz & K.Tolhurst

TAPM Modelling Studies of Cape Grim Dichloromethane **30**
M. Cox, S. Siems, P. Fraser, P. Hurley & G. Sturrock

Outline of Science Directions in a New Antarctic and Southern Ocean CRC **31**
T. Trull

Relationship Between Phytoplankton Production and Biogenic Gas Emission off Cape Grim

Guido Corno

Institute of Antarctic and Southern Ocean Studies, Hobart, Tasmania 7001

Abstract

The present project aimed to determine phytoplankton community structure, environmental factors controlling phytoplankton biomass and possible relationships between phytoplankton abundance and species with atmospheric and seawater concentrations of methanesulphonic acid (MSA), methyl bromide (CH_3Br) and methyl iodide (CH_3I) during spring-autumn 2000/2001 in coastal waters off Cape Grim, Tasmania.

Aterionellopsis glacialis, *Chaetoceros simplex*, *Rhizosolenia* sp and small flagellates *Pavlova* sp, *Phaeocystis* sp dominated the phytoplankton community at all times; these compromised 26% and 41% of the total phytoplankton abundance, respectively. Dinoflagellates and coccolithophores were found at low concentrations. This particular community structure was interpreted as an indication of high turbulence in the water column and r-strategist species dominated.

Phytoplankton biomass was low (0.10 mg Chl *a*/m^3) during mid-spring and early summer, mainly due to deep mixing events and low light availability, indicated by deep Mixed Layer Depth (MLD) (40m) and shallow Euphotic Zone Depth (EZD). In mid-summer, a first minor phytoplankton increase (0.67 mg Chl *a*/m^3) occurred, as a result of a shallower MLD (22m) than the EZD (28m). A second major increase (1.10 mg Chl *a*/m^3) followed in early autumn due to a large increase in nitrate concentrations (2.28 mol/L) through the water column. In this period, advection of subantarctic waters in the sampling region caused this enhance in nitrate concentrations. In late autumn, phytoplankton biomass decreased (0.45mg Chl *a*/m^3) gradually due low light availability and nutrient depletion. These results highlight the instability and variability of the water column and suggest that these waters might be considered of mixed origin and not exclusively temperate.

Variable fluorescence (F_V/F_M), a measure of phytoplankton activity and absorption cross-section (σ_{PS2}) were both spatially and temporally variable through the water column. Low nitrate, in surface layers, and light availability, in deeper layers (10-20m) decreased phytoplankton activity and increased σ_{PS2}. After *in situ* and laboratory nutrient addition, fluorescence perturbations were also used to assess possible nutrient limitations in phytoplankton assemblages. After nitrate addition, an increase in fluorescence was indicative of a nitrate limiting condition (< 1.00 μmol/L); similarly, after phosphate addition, a decrease in fluorescence suggested a possible phosphate limiting conditions. These preliminary results proposed this bioassay as a possible new, cheap, real-time and *in situ* method to measure nutrient limitation.

MSA concentrations were not related with phytoplankton biomass and species in coastal waters. However, analysis of SEAWIFS images revealed that open ocean coccolithophores abundance was responsible for MSA variations in this region. These results suggest coccolithophores as a possible source of MSA in the atmosphere at Cape Grim. Laboratory experiments confirmed that coccolithophores (*Emiliania huxleyi*) produce more dymethylsulphide, a precursor of MSA, than diatoms (*Cylindrotheca closterium*) and small flagellates (*Phaeocystis* sp).

Methyl halides seawater concentrations were well related with phytoplankton biomass, particularly CH_3I (r^2=0.89). Furthermore, changes in diatoms and small flagellates abundance were closely linked to variations in methyl halides concentrations. These results indicate phytoplankton as a good source of methyl halides in these waters; in particular, diatoms and small flagellates might be considered as methyl halides species producers. Low nitrate concentrations (<1.00 μmol/L) were associated with high methyl halides concentrations. This suggests that the production of these gases by phytoplankton might be as response to nitrate limiting conditions.

gcorno@bigpond.com

A Brief Review of Key Characteristics of Radon Measurements at Cape Grim 1987-2001

Wlodek Zahorowski, Scott Chambers, Sylvester Werczynski & Ann Henderson-Sellers

Australian Nuclear Science and Technology Organisation, Menai, NSW, 2234

Abstract

Following the processing and release of the Cape Grim radon dataset for the period 1997 to 2001, an amended dataset including all data from 1987 to 2001 has been compiled and examined.

Based on the amended dataset, several key characteristics have been re-calculated and discussed. These include inter-annual and seasonal variations in baseline and non-baseline sectors, a discussion of background of the past and present instruments as well as other evident trends on different time scales and wind sectors.

A brief introduction to a new web-based viewer of the dataset and its major features is also provided.

The Aerosol Transmission Efficiency of the Cape Grim 10-m Inlet

Henry Granek & John Gras

CSIRO Atmospheric Research, Aspendale, Victoria 3195

David Paterson

CSIRO Building, Construction & Engineering, Highett, Victoria 3190

Abstract

The aerosol transmission efficiency of the 10 m inlet has been modelled using finite element techniques (CFX software). We examined particles in the range 1-20 μm aerodynamic diameter with a range of wind speeds and angle of attack values. Computed transmission efficiencies were close to 100 percent for the smaller particles in this range but fall to near zero above about 20 μm. When the incident flow is at small inclined angles, some enhancement or depletion is observed in the calculated particle concentration.

Observation of Ultrafine Aerosol Particles in the Marine Environment of Southeastern Australia

Salah Jimi

CSIRO Atmospheric Research, Aspendale Victoria 3195
School of Mathematical Sciences, Monash University, Clayton Victoria 3800

John Gras & Paul Krummel

CSIRO Atmospheric Research, Aspendale Victoria 3195

Steve Siems

School of Mathematical Sciences, Monash University, Clayton Victoria 3800

Keywords: Ultrafine, MBL, Free Troposphere, Frontal Passage

Abstract

Three potential source regions contributed to ultrafine (UF) aerosol particle concentration measured in the MBL of Cape Grim. This conclusion was drawn based on in-situ observations made at the Australian Cape Grim Baseline Air Pollution Station (CGBAPS) during 1999-2000. The three sources identified included local sources from Tasmania, remote sources from the Australian continent and a relatively weak natural source from the clean Baseline sector. The seasonal UF diurnal cycles showed a strong daytime source in the Tasmanian and Continental sectors and a relatively weak source during Baseline flow. The Tasmanian influence coincided more strongly with the morning than with the afternoon peak hours of the day. In the case of the continental influence, the daytime peak in concentration was delayed due to the remoteness of Cape Grim from the Australian continent.

The other important outcome of this study was the observation of UF peak a few hours after frontal passages. On average, the concentration of this fraction of particles started to peak up 6-8 hours after frontal passages and lasted for over a day. These results are consistent with Bates *et al*., 1998 observations made during the first Aerosol Characterization Experiment (ACE-1), which was carried out in the MBL over the Southern Ocean in 1995. The maximum UF peak observed in this study was in December 2000, which reached to about 1000cm^{-3}. This level of concentration was approximately one order of magnitude higher than the typical marine background concentration at Cape Grim. Clearly defined UF seasonal cycles were evident, lowest concentration in winter and progressively increased as the other seasons approached. This supports the idea that UF peaks observed after frontal passages were due to the formation of new particles initiated by photochemical processes and subsequent growth of the recently formed particles to a detectable size (3nm). Possible explanations for the time delay in the UF events relative to the time of frontal passage will be discussed. Concentrations of UF particles presented in this work are median values.

References

Bates, T. S., Kapustin, V. N., Quinn, P. K., Covert, D. S., Coffma, D. J., Mari, C., Durkee, P. A., De Bruyn, W. J. and Saltzman, E. S., Processes controlling the distribution of aerosol particles in the lower marine boundary layer during the First Aerosol Characterisation Experiment., *J. Geophys. Res*., 103, 16,369-16383, 1998.

salah.jimi@maths.monash.edu.au

The 25-year Cape Grim *in situ* CO_2 Record

Paul Steele, Graeme Pearman, David Beardsmore, Fred de Silva, Paul Krummel & Ray Langenfelds

CSIRO Atmospheric Research, Aspendale Victoria 3195

Cape Grim Staff

Cape Grim Baseline Air Pollution Station, Smithton, Tasmania 7330

Abstract

As one of the core Cape Grim programs since inception, the Cape Grim *in situ* CO_2 record is providing valuable information on the seasonal and higher frequency CO_2 variations in the Australasian region. Publication of longer-term trends in the full data set has been delayed by uncertainties in calibration propagation. Those uncertainties have now been addressed and the full record available for wide use. The full record is a striking visualisation of the Cape Grim CO_2 climatology.

The Interannual Variation in Global Atmospheric $\delta^{13}C$ and its Link to Net Terrestrial CO_2 Exchange

Roger Francey, Colin Allison, Cathy Trudinger, Peter Rayner, Ian Enting, Paul Steele & Lisa Cooper

CSIRO Atmospheric Research, Aspendale Victoria 3195

Cape Grim staff

Cape Grim Baseline Air Pollution Station, Smithton, Tasmania 7330

Abstract

The two-decade-plus records of the stable isotopes in CO_2 at Cape Grim have a strong claim (based on recent recognition of the main systematic biases influencing past data) as the most reliable records of these important tracers of the global carbon budget. A recent reanalysis of the $\delta^{13}C$ record achieves, for the first time, a partitioning of fossil fuel CO_2 uptake between oceans and land that is consistent with emerging estimates from ocean and terrestrial communities. Whereas the $\delta^{13}C$ signal is most easily explained by net exchanges with terrestrial reservoirs, (the accompanying $\delta^{18}O$ record exhibits a strong links with the gross carbon turnover in plants and soil, and the isotopic composition of soil and leaf water).

Future CO_2 Isotope Monitoring at Cape Grim

Colin Allison & Roger Francey

CSIRO Atmospheric Research, Aspendale Victoria 3195

Laurie Porter

Cape Grim Baseline Air Pollution Station, Smithton, Tasmania 7330

Abstract

Progress on the upgrading and automation of the Cape Grim *in situ* CO_2 extraction line for isotopic measurements will be reported, including results from the introduction of surveillance air standards. The potential of higher frequency, more precise monitoring of $\delta^{13}C$ will be explored using synthetic data in the Rayner *et al*. time dependent 3D Inversion model.

Reference

Rayner, P. J., I. G. Enting, R. J. Francey, and R. L. Langenfelds, Reconstructing the recent carbon cycle from atmospheric CO_2, $\delta^{13}C$ and O_2/N_2 observations, *Tellus*, 51B, 213-232, 1999.

The Future of CO_2 Measurement at Cape Grim

Paul Steele, Darren Spencer, Paul Krummel, Roger Francey, Rachel Law, Grant Da Costa & CSIRO Engineering Staff

CSIRO Atmospheric Research, Aspendale Victoria 3195

Cape Grim Staff

Cape Grim Baseline Air Pollution Station, Smithton, Tasmania 7330

Abstract

The LOFLO CO_2 analyser system is a forerunner to significant changes in the way that CO_2 will be monitored in the future. These will be explored.

Solar FTIR Remote Sensing of Bushfire Plumes over Wollongong, December 2001 - January 2002

Arndt Meier, Nicholas Jones & David Griffith

Chemistry Department, University of Wollongong, Wollongong, NSW 2522

Abstract

During the recent NSW bushfires we collected over 400 solar FTIR spectra through the smoke in Wollongong. Visibility was as low as 100-200m. The spectra show very high enhancements of a number of species, including CO2, CO, CH4, CH2O, NH3 HCN, C2 hydrocarbons and many others. We will present a short preview of the data we have collected and some preliminary analysis.

Trace Gas Emissions from Melbourne and Europe Deduced from AGAGE Observations at Cape Grim and Mace Head

Paul Fraser, Paul Steele & Nada Derek

CSIRO Atmospheric Research, Aspendale, Victoria 3195

Bronwyn Dunse

CSIRO Atmospheric Research, Aspendale, Victoria 3195
Chemistry Department, University of Wollongong, Wollongong, NSW 2522

Stephen Wilson

Chemistry Department, University of Wollongong, Wollongong, NSW 2522

Michelle Cox

York University, Ontario, Canada

Simon O'Doherty & Peter Simmonds

School of Chemistry, University of Bristol, Bristol UK

Abstract

AGAGE *in situ* observations of CFCs, HCFCs, HFCs and other trace gases at Cape Grim, Tasmania, and Mace Head, Ireland, have been used to deduce regional emissions of these species using transport models and also by inter-species correlation techniques. This paper will present results from three regional emissions studies and show how emissions from these regions have responded to changes in consumption brought about by the Montreal Protocol.

Recent Changes in the Global Abundance of Methyl Bromide from AGAGE and SIO Measurements

Paul Fraser, David Etheridge, Cathy Trudinger & Nada Derek

CSIRO Atmospheric Research, Aspendale, Victoria 3195

Laurie Porter

Cape Grim Baseline Air Pollution Station, Smithton, Tasmania 7330

Michelle Cox

Centre for Atmospheric Chemistry, York University, North York, Canada
formerly at
School of Mathematical Sciences, Monash University, Clayton Victoria 3800

Simon O'Doherty & Peter Simmonds

School of Chemistry, University of Bristol, Bristol UK

Ben Miller & Ray Weiss

SIO, University of California at San Diego, La Jolla, California, USA

Abstract

Methyl bromide (CH_3Br) is a significant ozone depleting substance and its global consumption is controlled by the Montreal Protocol. Reliable, long-term measurements of CH_3Br are scarce and *in situ* AGAGE measurements at Cape Grim, Tasmania, and Mace Head, Ireland, are now available following intensive efforts to provide a reliable calibration for this difficult-to-measure species.

This paper examines long-term measurements from Cape Grim (*in situ* and archive), Mace Head (*in situ*) and Trinidad Head, California (flask). Evidence is accumulating that the Montreal Protocol may have already had an effect on the atmospheric abundance of this short-lived, but important, source of stratospheric bromine.

Aerosol Chemistry at Cape Grim: What do we know?

Melita Keywood

CSIRO Atmospheric Research, Aspendale, Victoria 3195

Abstract

Various aspects of the chemical composition of aerosol collected at Cape Grim have been measured since the inception of the Cape Grim Baseline Station in 1976. This presentation will describe a climatology of the aerosol chemistry at Cape Grim, by drawing upon published results from the different measurement programs carried out at Cape Grim over the past 25 years. This includes some extended studies as well as short-term projects. In addition, an analysis of the 25-year HiVol sampler aerosol chemistry record will be described and recommendations for strengthening the aerosol chemistry program at Cape Grim and its role in the wider GAW aerosol program will be made.

Oxygen Isotopes and Palaeoenvironment Reconstruction

Pauline Treble

Research School of Earth Sciences, Australian National University, Canberra, ACT 2000

Abstract

Speleothems (cave stalagmites and flowstones) have the potential to provide the terrestrial equivalent of the detailed and multi-proxy marine records derived from deep-sea sediment cores and corals. Oxygen is the key element for palaeoclimate reconstruction from speleothems. Its isotopic composition in speleothem calcite ($\delta^{18}O_c$) is dependent on the isotopic composition of its meteoric rainfall source ($\delta^{18}O_w$) and also the cave temperature. Thus, speleothems are potentially a record of both temperature and rainfall variations, which may be expressed in a simple equation as follows:

$$\Delta\delta^{18}O_c = {}^{1}\Delta\delta^{18}O_{\text{cave-temperature}} + \Delta\delta^{18}O_w \ {}^{2}[+ \Delta\delta^{18}O_{\text{ice-volume}}] \qquad \text{(Equation 1)}$$

[1]May be calculated using the known fractionation factor for inorganic precipitated calcite (-0.24‰/°C; McCrea, 1950).
[2]The isotopic shift in sea-water due to continental glacier building, $\Delta\delta^{18}O_{\text{ice-volume}}$, is an additional parameter for glacial periods (see Shrag *et al*., 1996).

In many palaeoclimate reconstructions $\delta^{18}O_w$ is assumed to obey a simple global relationship between $\delta^{18}O_w$ and site temperature (+0.69‰/°C; Dansgaard, 1964) meaning that any variation in $\delta^{18}O_w$ could simply be accounted for by temperature and so Equation 1 becomes:

$$\Delta\delta^{18}O_c = +0.45‰ \text{ x } T_{\text{cave-temperature}} [+ \Delta\delta^{18}O_{\text{ice-volume}}] \qquad \text{(Equation 2)}$$

However, replicated speleothem $\delta^{18}O_c$ records constructed for the late Holocene (last 2000 years) in Tasmania show variations that cannot be accounted for by temperature alone. This study is collecting event-based rainfall samples from Cape Grim and several cave sites in Tasmania to investigate whether Dansgaard's relationship, +0.69‰/°C holds true for rainfall from this area.

Dansgaard, W., 1964. Stable isotopes in precipitation. *Tellus* 4: 436-468.

McCrea, J. M., 1950. On the isotopic chemistry of carbonates and a paleotemperature scale. *Journal of Chemical Physics* 18: 849-857.

Schrag, D. P., Hampt, G. and Murray, D. W., 1996. Pore fluid constraints on the temperature and oxygen isotopic composition of the glacial ocean. *Science* 272: 1930-1932.

First Year of Radon-222 Observations at the Ace-Asia Kosan Site

Wlodek Zahorowski, Scott Chambers & Ann Henderson-Sellers

Australian Nuclear Science and Technology Organisation, Menai, NSW 2234

Chang-Hee Kang

Cheju National University, Cheju, Korea

Jiyoung Kim & Sung-Nam Oh

Meteorological Research Institute, Seoul, Korea

Abstract

A preliminary analysis of the first year of radon measurements at the Kosan ACE-Asia super site (Cheju Island, Korea; 33°17'N, 126°10'E) is presented and contrasted with radon observations at the Cape Grim Baseline Air Pollution station. Seasonal analyses have been centred about the first ACE-Asia Intensive Operation Period (March-May 2001). At Kosan a pronounced seasonality is evident in the observed radon concentrations. Average radon concentrations in winter are markedly higher than in summer. These changes are brought about by a combination of three effects: (i) seasonally increased dilution in the atmospheric boundary layer, (ii) longer air mass transit times to Cheju Island over water due to reduced wind speed, and (iii) seasonal changes in origin of aged air masses. The most surprising result is a fairly isotropic distribution of radon concentration with wind direction for two of the three seasons so far observed. These observations contrast with similar observations at Cape Grim considering the relatively well defined continental and oceanic sectors around the Kosan site. This indicates that the regional meteorology around Kosan is particularly complex, especially in winter and spring, and that radon is an indispensable experimental tracer of air mass origin.

Radon-222 Measurements at a Continental Coastal Site in Hong Kong

Scott Chambers, Wlodek Zahorowski & Ann Henderson-Sellers

Australian Nuclear Science and Technology Organisation, Menai, NSW 2234

Tao Wang & Steven Poon

The Hong Kong Polytechnic University, Hung Hom, Kowloom, Hong Kong

Abstract

In conjunction with several international collaborators, the Australian Nuclear Science and Technology Organisation (ANSTO) has installed, and is operating, a network of four radon detectors in south east Asia and the Pacific Ocean as part of the ACE-Asia campaign. The site network includes Hok Tsui (Hong Kong), Kosan (Korea), Sado Island (Japan) and Mauna Loa (Hawaii). The observation sites in south east Asia are spread latitudinally to cover regions dominated by aerosols of both anthropogenic and natural origin. The Hok Tsui site (114°15'E, 22°13'N) is the southernmost site in the study region and has been operational since January 2001. We present a summary of the first year of operation at this site including preliminary monthly and seasonal analyses and contrast the observations with those made at Cape Grim Baseline Air Pollution Station. In Hong Kong, seasonal changes in average radon concentration were observed, with winter values almost four times greater than summer values. This change corresponds to a pronounced seasonal change in wind direction from north to northeast in winter to roughly east-west in summer. In general, air mass fetch from this site is continental to the north and west, and oceanic to the east and south. The hourly radon concentrations indicate a regular occurrence of near baseline conditions for wind fetch over the oceanic sector in summer. A wider spread of concentrations is evident in winter when land fetch is more common and wind speeds higher. The pronounced seasonality in mean radon concentrations indicates that air masses arriving at the site have experienced a long term trajectory that is relatively consistent with their direction of travel upon reaching the site.

In Situ Investigation of Tomato Plants as Methyl Halide Sources

Brad Hall

National Oceanic and Atmospheric Administration, Climate Monitoring and Diagnostics Laboratory
Boulder, Colorado, USA

In Situ Measurements of Carbonyl Sulfide and Methyl Chloride

Brad Hall

National Oceanic and Atmospheric Administration, Climate Monitoring and Diagnostics Laboratory
Boulder, Colorado, USA

A Pollution History of the Southern Hemisphere recorded by Lead Isotope Measurements in Antarctic Ice

Paul Vallelonga, Katja van de Velde, Jean-Pierre Candelone, & Kevin J. R. Rosman

Department of Applied Physics, Curtin University of Technology, Perth, WA, 6845

Vin I. Morgan

Australian Antarctic Division, Kingston, Tasmania 7050

The following five posters are from

The Sixth International Carbon Dioxide Conference, Sendai, Japan 1-5 October 2001

Stable Isotopes of Atmospheric Carbon Dioxide from the CSIRO Global Flask Sampling Network

Colin Allison, Roger Francey & Peter Rayner

CSIRO Atmospheric Research, Aspendale, Victoria 3195

Future Directions in Atmospheric CO_2 Measurement Methods

Paul Steele, Grant Da Costa, Darren Spencer, Paul Krummel, Roger Francey & John Bennett

CSIRO Atmospheric Research, Aspendale, Victoria 3195

Stuart Baly & Laurie Porter

Cape Grim Baseline Air Pollution Station, Smithton, Tasmania 7330

The Interannual Variation in the $\delta^{18}O$ of Atmospheric CO_2 Over the Last 25 Years

Roger Francey & Colin Allison

CSIRO Atmospheric Research, Aspendale, Victoria 3195

Philippe Ciais & Giorg Hoffmann

Laboratoire des Sciences du Climat et de l'Environnement, Orme des Merisiers, Gif-sur-Yvette, France

CO_2 Inversions using High Temporal Frequency Data

Rachel Law, Peter Rayner, Paul Steele & Ian Enting

CSIRO Atmospheric Research, Aspendale, Victoria 3195

A Kalman Filter Double Deconvolution of Ice Core CO_2 and $\delta^{13}C$ Data

Cathy Trudinger, Ian Enting, Peter Rayner & Roger Francey

CSIRO Atmospheric Research, Aspendale, Victoria 3195

Isotopic Fractionation in Sources of Atmospheric N_2O

Stephen Wilson, David Griffith, Travis Naylor, Joanne Menegazzo & Fred Turatti

Chemistry Department, University of Wollongong, Wollongong, NSW 2522

Abstract

Development and Verification of a Spatially Explicit Inventory of Methane Emissions from Australia

Ying Ping Wang & Simon Bentley

CSIRO Atmospheric Research, Aspendale, Victoria 3195

Abstract

A spatially explicit inventory of methane emissions was compiled for Australia covering livestock, coal mining, gas distribution, fossil fuel combustion, waste and soil uptake. This inventory is constructed on a 75km x 75 km grid using data from local government areas and point source data. The methodology for anthropogenic sources is very closely comparable with that of the Australian National Greenhouse Gas Inventory (NGGI). A regional atmospheric model with a domain covering the continent of Australia and its surrounding oceans is used to estimate the time-varying influences of the spatially dependent emissions from the various regions of Australia upon surface methane concentrations continuously observed at Cape Grim, Tasmania (41°S, 147°E). These influences are used within a Bayesian synthesis inversion to refine the regional totals of surface emissions and uptake of methane as aggregated from the spatially explicit inventory. Based upon this inverse analysis, the NGGI is considered to overestimate net emissions from south-east Australia and Tasmania in 1997 by about 40%.

Air Mass Origin – Some Sources of Error

Matthew Tully & Arthur Downey

Bureau of Meteorology, Melbourne, Victoria 3001

Abstract

96 hour back trajectories, terminating at Cape Grim, are calculated and archived daily. They are currently computed using data from the Bureau of Meteorology's Limited Area Prediction System (LAPS) (Puri *et al*., 1998) using the HYSPLIT model (Draxler & Hess, 1998). In this paper we investigate the accuracy of the trajectories using radon as a tracer. We consider the effect of selecting different vertical motion schemes (isobaric, sigma, isentropic, isopycnic and from the data). The accuracy of trajectories sorted by the Mean Sea Level Pressure on arrival at Cape Grim is also studied. This gives a first approximation to the effect of synoptic complexity of the flow on the reliability.

Reference

Draxler, R. R. and G.D. Hess, An Overview of the HYSPLIT_4 Modelling System for Trajectories, Dispersion and Deposition, *Aust. Met. Mag.*, 47, 295-308, 1998.

Puri, K., G. S., Dietachmayer, G. A., Mills, N. E., Davidson, R. Bowen, and L. W. Logan, The New BMRC Limited Area Prediction System, LAPS, *Aust. Met. Mag*., 47, 203-223, 1998.

Atmospheric Composition Changes During the Past Century from Firn Air from Two Antarctic Sites

David Etheridge, Cathy Trudinger, Ray Langenfelds, Paul Steele, Paul Fraser & Roger Francey

CSIRO Atmospheric Research, Aspendale, Victoria 3195

David Lowe

National Institute of Water and Atmospheric Research, Kilbirnie, New Zealand

Andrew Smith

Australian Nuclear Science and Technology Organisation, Physics Division, Menai, NSW, 2234

Georgina Sturrock

School of Environmental Sciences, University of East Anglia, Norwich, UK

Laurie Porter

Cape Grim Baseline Air Pollution Station, Smithton, Tasmania 7330

Alan Elcheick

Antarctic CRC, Hobart, Tasmania

Mark Battle

Bowdoin College, Department of Physics and Astronomy, College Station, Brunswick, USA.

Abstract

Measurements of air collected from firn are used to produce atmospheric trace gas records over the last century. This presentation will show

- the reconstruction of atmospheric histories by forward and inverse firn modelling
- the advantage of the narrow age spectral width of Law Dome firn air
- new measurements from South Pole firn air
- comparisons of firn air and Cape Grim records

david.etheridge@csiro.au

CSIRO‘s commitment to Cape Grim in a world of BHAGs, Emerging Science and IP Revaluation

Greg Ayers

CSIRO Atmospheric Research, Aspendale Victoria 3195

Abstract

Middle Atmosphere Research at the Australian Antarctic Division

Marc Duldig

Australian Antarctic Division, Kingston, Tasmania 7050

Abstract

Australian Antarctic Research operates through an advisory committee appointed by the national government. The research is divided into ten programs: Antarctic Marine Living Resources; Astronomy; Biology; Geology; Glaciology; Human Impacts; Medical research; Meteorology; Oceanography and Space and Atmospheric Sciences (SAS). Most of these programs are coordinated and led by Program Leaders based at the Australian Antarctic Division.

The SAS program operates experiments examining the Antarctic atmosphere above the troposphere. It also includes research in ionospheric and cosmic ray physics from both Australia and Antarctica. Atmospheric observations are based around a LIDAR facility at Davis. Other experiments include Czerny-Turner and Fourier Transform spectrometers measuring OH emissions, MFSA radar observations of the mesosphere, 12 hourly sonde balloon flights and some UV monitoring. A VHF radar is presently being designed for installation in the southern summer of 2002/3.

A description of the research and the range of experiments operating at the three Australian Antarctic bases and the sub-Antarctic Macquarie Island will be presented.

Measurements of Carbonyl Sulfide at CMDL Baseline Observatories

Brad Hall & Steve Montzka

National Oceanic and Atmospheric Administration, Climate Monitoring and Diagnostics Laboratory
Boulder, Colorado, USA

Geoff Dutton

Cooperative Institute for Research in Environmental Sciences, University of Colorado
Boulder, Colorado, USA

Abstract

Carbonyl sulfide (COS) has recently been added to the list of trace gases measured by the Halocarbons and other Atmospheric Trace Species (HATS) group within CMDL. Routine measurements of COS at CMDL baseline observatories may provide insight into the sources, sinks, and long-term trends of this poorly understood trace gas. COS measurements are obtained from both flask samples and *in situ* instruments. From nearly three years of data (at some sites), a strong seasonal cycle has been observed in the northern hemisphere. A smaller seasonal cycle, only a few months out of phase, is observed at two sites in the southern hemisphere (Cape Grim and South Pole), but not at American Samoa. *In situ* observations at Mauna Loa, Hawaii reveal elevated COS mixing ratios associated with both local and long-range pollution events. Elevated mixing ratios of COS, CH_3Cl, CH_4, and halon-1211 are associated with long-range transport of air from Asia. Work is also underway to develop a COS calibration scale based on gravimetrically-prepared standards.

A Spatially Explicit Inventory of Trace Gas Emissions from Wildfires and Controlled Burning over Australia

Mick Meyer & Ian Galbally

CSIRO Atmospheric Research, Aspendale, Victoria 3195

Garry Cook

CSIRO Sustainable Ecosystems, Canberra, ACT 2912

Damian Barrett

CSIRO Plant Industry, Canberra, ACT 2601

Kevin Tolhurst

Faculty of Agriculture and Forestry, University of Melbourne, Creswick, Victoria 3363

Dean Graetz

CSIRO Atmospheric Research, ANU, Acton, ACT 2601

Abstract

Australia is the driest continent and its landscape is regularly burned by wildfires and controlled burning. These fires contribute more than 65% of carbon monoxide and nitric oxide to the Australian total emissions and therefore have a major impact on the regional air quality. In this paper we present the first comprehensive spatially explicit analysis of the extent and amount biomass burning in Australia and the resultant release of trace gases. The analysis utilises satellite-based remote sensing of fire scars, ground based records of smaller fires, primarily forest fires and controlled burns; direct observations and biological modelling of fuel loads; locally observed fuel composition, and emission factors averaged within each of the 80 biogeographical regions of Australia. Ninety percent of the burning occurs in northern Australia. Approximately 5% of the Australian land surface is burned annually, and approximately 10% of the net primary productivity of the continent is consumed in these fires. The release of trace gases from biomass burning over Australia, for several major trace species including CO_2, CO, N_2O, NO_x and total non-methane hydrocarbons and the uncertainty in the emission estimates will be discussed.

TAPM Modelling Studies of Cape Grim Dichloromethane

Michelle Cox

Centre for Atmospheric Chemistry, York University, North York, Canada
formerly at
School of Mathematical Sciences, Monash University, Clayton Victoria 3800

Steve Siems

School of Mathematical Sciences, Monash University, Clayton Victoria 3800

Paul Fraser & Peter Hurley

CSIRO Atmospheric Research, Aspendale, Victoria 3195

Georgina Sturrock

School of Environmental Sciences, University of East Anglia, UK
formerly at
CSIRO Atmospheric Research, Aspendale, Victoria 3195

Abstract

A coupled prognostic meteorological and transport-chemistry model called TAPM (The Air Pollution Model) developed at CSIRO AR (Hurley 1999a,b) was used to simulate the CH_2Cl_2 Cape Grim observations. Analysis of the dichloromethane data using back trajectory statistics showed that the main source region relevant to the Cape Grim CH_2Cl_2 observations was the PPR region. A detailed Victorian EPA Port Phillip Region (PPR) inventory was available for dichloromethane with gridded area and point sources and this was used as input to TAPM to simulate the pollution transport from Melbourne to Cape Grim. Month long TAPM modelling studies were performed for the months from June 1998 to November 1999. The model predictions at the grid point closest to Cape Grim were compared to the AGAGE CH_2Cl_2 observations for this period. The model predictions were about 5 times lower on average than the observations. Errors in the model's meteorological predictions were not found to be a significant source of error in the CH_2Cl_2 predictions. Import statistics of CH_2Cl_2 into Victoria were about a factor of 3 higher than the Victorian EPA estimate, assuming that 80% of the amount imported into Victoria was released into the PPR region. Therefore the Victorian EPA inventory for CH_2Cl_2 inventory may be in error.

Outline of Science Directions in a New Antarctic and Southern Ocean CRC

Tom Trull

Antarctic CRC, University of Tasmania, Hobart, Tasmania

As part of the Workshop on Marine-Related Cape Grim Research